METHOD OF CREASING A PACKAGING LAMINATE, A PACKAGING LAMINATE AND A PACKAGING

TECHNICAL FIELD

The present invention relates to a method of creasing a packaging laminate manufactured from cellulose fibres, which packaging laminate comprises a bulk promoting layer, here denoted bulk layer, which consists of a network structure of cellulose fibres, and on at least one side of the bulk layer at least one side layer, the side layer and bulk layer being directly or indirectly joined to each other over essentially their entire surfaces facing each other.

PRIOR ART AND PROBLEMS

In the manufacturing of packagings, a material which normally consists of a packaging laminate, is creased, whereby a creasing device is being used to make an indentation in the material. Said creasing device may be shaped as a thin ruler with a rounded, smooth edge, or as a grooving wheel with a rounded, smooth edge, which presses the material down in a carefully formed indentation in a matrix. By this indentation, the material is weakened in a so called crease line. At the creasing, laminate material is transferred out of the plane of the laminate, whereby a projection is formed at the crease line on one side of the laminate, namely the opposite side to the side on which the indentation has been made. Thereby, the crease line acts as a folding impression in order to make possible a straight folding of the material to a desired angle, which usually is 90°, but also other angles, e.g. 180° may occur. Different geometries of the crease ruler or the like and the matrix are used for different material qualities (corresponding to different laminate qualities and laminate types) of different material properties, in order to obtain a folding impression which is as well defined as possible. What is usually varied is the thickness of the ruler or some other creasing device, the width of the indentation in the matrix or the creasing depth, i.e. how deep the creasing device is pressed.

A conventional folding is characterised by folding away from the side in which the indentation in the material has been done. Thereby, a bulge is formed on the inside of the angle formed in connection with the folding. At a folding of e.g. 180° this will mean that the folded laminate will exhibit a thickness which is more than twice the thickness of the double laminate. Also at smaller angles, such creasing and folding will lead to a bulge which extends along the crease line on the inside of the angle.

The reason for a bulge being formed when folding a conventional laminate, is that a compression fracture is initiated on the side of the laminate which is subjected to compression at the folding. The compression fracture grows by the act of folding compressing the projection formed by the creasing ruler into a bulge. Due to the collection of material in the folding line, the laminate has a tendency to spring back to its original planar shape. This means that the folding edges easily becomes rounded, especially in connection with being subjected to a load, e.g. as a hand grip is taken on a packaging of parallelepiped shape or at stacking several packagings on top of each other.

Thus, problems and disadvantages in connection with conventional creasing of a conventional laminate, are transfer of material out of the plane and/or a material transfer to the folding line, which results in a bulge and in an increased thickness of the folded laminate, but also problems related thereto in that the folding line, due to the deformations, will not be perfectly straight, which besides from being an aesthetic deficiency, will result in differently shaped packagings which are to be stacked side by side or on top of each other. The deformations in the folding line may also serve as fractural impressions in possible barrier layers or film layers consisting for example of aluminium film, plastic film, lacquer or the like. If e.g. a film has been applied on one side of the laminate, and the film material is more brittle than the paperboard of the laminate, a bulge or some other irregularity which occurs at the folding, may initiate a crack in the film layer. Exclusive paperboard qualities, which possibly require printing or a surface finish of high quality, may be coated, printed with a dark colour, lacquered or the like. Thereby, an impression by a crease ruler may result in damages in the surface coating, which may be taken for cracks that expose the underlying fibre material, when the folding is performed away from the crease ruler indentation.

A known method of decreasing the bulge problem is presented in SE 467 302, in which the projecting crease ruler deformation is removed by mechanical machining. The method however exhibits a number of disadvantages, such as strength reduction, dusting, etc.

Another known method, which aims at lessening the effect of bulge formation, is presented in SE 432 918, in which assisting crease lines are used in order to transfer material from the crease line itself.

It is also generally known to arrange a number of parallel crease lines, whereby one angle is divided into a number of angles arranged next to each other. However, the disadvantage of this method is that a very large total thickness is achieved. For example at a folding of 180°, the total thickness will become considerably larger than double the laminate thickness.

Yet another way of moving the bulge from the crease line is described in SE 507 095, the adhesion between different layers in the laminate being eliminated, so that they are deformed independently of each other.

In all of the above mentioned examples of solutions to the problem of material transfer in the fold line as a consequence of the deformation in connection with the creasing, it is typical that the strive is to remove or transfer material from the fold line, or as an alternative to avoid the collection of material in the fold line.

In EP 565 013, which relates to another kind of problem, a material consisting of several layers is described, a core being formed by pressed, shredded paper. It is also shown that the material may be provided with a number of grooves, which makes it flexible and whereby it can be used for the wrapping of objects of differing shape. Accordingly, the document does not relate to packagings formed by folding and does not show crease lines or a creasing method, in the established sense of the word.

In EP 484 726, there is described how a foamed or expanded binding agent is compressed at folding, in order to lessen elongation stresses in a layer of aluminium foil.

In EP 546 956 there is described a material which exhibits a centre layer of expanded cellulose fibres, which is stated to give an improved workability.

From US 2,770,406 it is known a packaging laminate, which laminate comprises a porous bulk layer, which is compressed when being folded. According to the document, the bulk layer is formed by a foamed plastic layer, especially a polystyrene layer with closed cells. Such a material was most certainly quite good in 1956, but considering the environmental demands, the demands of recycling etc. of today, it is absolutely a non desired material. In US 2,770,406 it is moreover stated that in a paperboard material of similar type as the one shown therein, cracks would arise in the outermost layer of kraft paper at the corners of the paperboard as being shaped. Thus, the problem with the

formation of cracks has, according to the document, only been solved in connection with a laminate consisting of both cellulose fibres and plastic, but definitely not in a laminate essentially being formed by cellulose fibres. Moreover, the document does not describe at all how the crease method itself has been done in reality.

FR 1,341,855 describes a laminate of corrugated paperboard, which of course does consist of cellulose fibres, but which differs from the laminate according to the present invention in that the bulk layer not is formed by a network structure of cellulose fibres, which is joined with a side layer of cellulose fibres over essentially their entire surfaces facing each other. In Fig. 2a-b in FR 1,341,855, there is shown prior art in relation to that application, which is stated to give problems with damages and deformations. Thus, the creasing according to Fig. 2a-b is presented as the method which results in the problems. In Fig. 3a-b there is shown a conventional creasing, which is stated to be somewhat better than the one shown in Fig. 2a-b, but the solution according to the invention of FR 1,341,855 instead consists of what is shown in Fig. 4a-c, i.e. a "creasing" where the outermost layer is cut through/perforated.

SOLUTION AND ADVANTAGES

The present invention aims at providing a creasing method for packaging laminates manufactured from cellulose fibres, which packaging laminate comprises a bulk promoting layer, here denoted bulk layer, and on at least one side of the bulk layer at least one side layer, side layer and bulk layer being joined together directly or indirectly, over essentially their entire surfaces facing each other, which method aims at avoiding the above problems.

The invention also relates to a packaging laminate which has been provided with crease lines according to the method, and a packaging which has been manufactured by folding such a laminate. The laminate is preferably used as a material for the packing of liquid and solid food and also for the packing of industrial goods and other merchandise, or as an intermediate product for the manufacturing of such material or other end products.

By the invention there is presented a creasing method for packaging laminates according to claim 1.

Thus, the creasing method is performed by aid of a creasing device which is pressed down into the laminate in a first side thereof, and by use of a planar holding-on tool on the opposite side of the laminate. Accordingly, the holding-on tool may consist of one

and the same planar and stable support, for all different types of crease lines. This will give a considerably simplified, faster and cheaper method, both in connection with the creasing method itself and in connection with an altered crease geometry, by only the pattern which consists of the creasing device being changed. In conventional creasing, both the pattern of the creasing device and the matrix must be changed when the crease geometry must be changed.

According to one aspect of the invention, the side layer(s) is/are arranged on said first side of the laminate, whereby in the method, said side layer is brought to sink into the bulk layer in the crease line, and whereby the laminate on the opposite side to the sunk down side layer(s) remains essentially planar in the area of the crease line.

In the creasing method, the bulk layer is compressed in the crease line, which constitutes a great advantage. The compression achieves a weakening in the network structure which is formed by the single cellulose fibres in the bulk layer. By this weakening in the network structure, it can not withstand the compression load which is achieved by the side layer, when this in turn is subjected to a compression load in connection with a subsequent folding in the crease line. This will result in the side layer sinking into the bulk layer. Thereby, problems with formation of bulges, delamination and the possible formation of cracks in the side layers, are avoided in a subsequent folding, which problems arise in connection with a conventional creasing method. The compressing behaviour of the bulk layer is achieved if an especially preferred laminate, which is described in the parallel patent application SE-A0-9802967-1, is used in the invention.

According to one aspect of the invention, the bulk layer essentially or entirely consists of a sheet of paper or paperboard, which is separately formed from cellulose fibres, in order to thereafter be laminated to the side layer(s), or is formed directly on the side layer(s). Thereby, wet laying or dry laying of the bulk layer may be used.

According to one aspect of the invention, the bulk layer consists to 40-95 % of cellulose fibres with a freeness of 550-950 ml CSF, the side layer(s) having a greater density than the bulk layer, and the laminate having a bending stiffness index greater than 2.5 Nm^7/kg^3, but less than 14 Nm^7/kg^3, calculated as a geometric mean value for machine and transverse direction.

According to another aspect of the invention, at least 60 % of the bulk layer consists of fibres with a freeness value greater than 600 ml CSF, the laminate having a bending stiffness index greater than 3.0 Nm^7/kg^3, or more preferred at least 60 % of the bulk layer consists of fibres with a freeness value greater than 650 ml CSF, most preferred at least 700, but less than 850 ml CSF, the laminate having a bending stiffness index greater than 4.0 Nm^7/kg^3. It is especially preferred that the laminate has a bending stiffness index greater than 5.0 Nm^7/kg^3.

Suitably, the bulk layer has a density of 50-300 kg/m^3, preferably 70-200 kg/m^3 and even more preferred 100-180 kg/m^3. The side layer preferably has a density which is at least twice as big, preferably at least three times as big and most preferred at least four times as big as the density of the bulk layer, the side layer suitably having a density of 300-1500 kg/m^3, preferably 400-850 kg/m^3. The bulk layer suitably has a basis weight of 30-300 g/m^2, preferably 40-120 g/m^2, the side layer(s) suitably having a basis layer of 20-150 g/m^2 and the laminate suitably having a basis weight of 50-500 g/m^2, preferably 90-200 g/m^2.

Said bulk layer with a low density may advantageously be manufactured by dry laying or wet laying of a chemi-thermomechanical pulp (CTMP) or some other "mechanical" pulp based on softwood, e.g. TMP, with a high freeness. From one aspect, dry laying is preferable, whereby any known technique may be used, but independent of the laying technique, the freeness of the pulp should be greater than 550 CSF, preferably greater than 600 CSF and more preferred greater than 650 CSF, most preferably greater than 700 CSF. A high freeness in the fibre material for said first layer ensures that the sheet may be pressed in connection with dewatering and consolidation of the sheet, without the density increasing to an undesired degree. Other fibre raw materials too with a high wet resiliency may, to a certain degree, be part of the bulk layer, e.g. chemically cross-linked fibres, which most often exhibit low dewatering resistance and high resiliency after wet pressing, but are not preferred, at least of cost reasons.

Other conceivable fibre raw materials are synthetic fibres, e.g. polyester, polyeten and polypropylene fibres, which also exhibit a low dewatering resistance and a high

resiliency in a wet state. In a preferred embodiment, the raw material for the layer of low density for the bulk layer, which normally shall form an intermediate layer in the laminate, is chosen entirely or essentially from mechanically produced, so called high yield pulps, i.e. pulps with at least 75%, suitably at least 80% wood yield, as for example CTMP and TMP pulps essentially based on softwood, providing that the pulps have the above specified freeness values.

To the bulk layer, there may also be added broke up to 25% of dry weight. Here, broke is defined as a classed-down product of the paper or paperboard laminate, which has been slushed in a pulper and exhibiting mainly separated fibres.

The bulk layer also comprises at least one binding agent, preferably a latex binder, in a content of 1-30%, preferably 5-30%, even more preferred 7-30% and most preferred 10-20% of the weight of the laminate, calculated as dry weight.

According to one aspect of the invention, at least any of the side layers consists of bleached or unbleached chemical sulphate, sulphite or organosolv cellulose pulp, which is preferably produced from a cellulose raw material consisting mainly of softwood and/or hardwood. The side layers may also comprise one or more barrier layers, such as e.g. layers of metal foil, preferably aluminium foil, polymeric film, metallised polymeric film or lacquer. Especially, an outermost layer, on the obverse side of the laminate, may consist of a film of any of the just mentioned materials, with a high finish.

It is to be realised that when the packaging laminate exhibits several side layers on the side of the bulk layer which is sunk down in the crease line(s), then all of these side layers will sink down into the bulk layer in connection with the crease method.

Yet another advantage of the invention, in connection with the forming of a packaging by folding a laminate provided with crease lines according to the invention, is that the folding may be performed either towards or away from the indentation which forms the crease line. At the folding of a laminate provided with crease lines according to a

conventional creasing method, the folding must always take place away from the indentation which has been done by the creasing device. A folding towards the indentation will result in a great advantage, especially in connection with laminates having a surface finish which is easily damaged and having high demands on the surface properties on the obverse side, which may then be creased from the back side instead.

DESCRIPTION OF THE DRAWINGS

In the following the invention will be described while referring to the figures, of which:

Fig. 1A-D	is showing a conventional creasing of a packaging laminate.
Fig. 2	is showing a slightly bent packaging laminate in connection with a conventional creasing.
Fig. 3	is showing a packaging laminate provided with a crease line according to the invention, as seen from the side.
Fig. 4	is showing the laminate in Fig. 3, after having been folded in the crease line.
Fig. 5	is showing a folding of the especially preferred packaging laminate, creased according to the invention.

Fig. 1A-D illustrates a conventional packaging laminate being creased by a conventional creasing method, the creasing of a paperboard laminate by a crease ruler against a matrix (Fig. 1A), the problems of prior art according to the above being illustrated: the permanent deformation out of the plane after a conventional creasing (Fig. 1B), the formation of a bulge/delamination in the folding line (Fig. 1C) and the permanent increase in thickness at a folding to 180° (Fig. 1D).

Fig. 2 is showing an initial compression fracture in the side layer which is exposed to a compression load in connection with a conventional creasing. The compression fracture will then grow to a formation of a bulge according to Fig. 1C.

In Fig. 3, there is shown a creasing method for a packaging laminate, according to the invention. The laminate comprises a bulk promoting layer 1, a side layer 2b on a first side of the laminate and two side layers 2a, 3 on a second side of the laminate. The outermost side layer 3 on the second side of the laminate consists, in the shown embodiment, of an exclusive surface layer with a high finish. The laminate is being creased by a creasing device 6, whereby there is formed a crease line 4, and whereby the bulk layer is brought to exhibit a compression 5 in the area of the crease line 4. Thereby. the side layer 2b is brought to sink down into the bulk layer 1. On the second side of the laminate, the laminate including the side layers 2a and 3, is planar, thanks to the holding-on tool 7 used in connection with the creasing method being planar.

In Fig. 4 there is shown how a 90° folding has been performed in the crease line 4. Thereby, it is clear that the folding has been performed towards the layer 2b sunk down side in the first side of the laminate. This means that the exclusive and brittle side layer 3 will not be damaged neither in connection with the creasing, nor in connection with the folding. It is also clear that a bulge or similar deformation, most beneficially, is not formed at the folding line, nor that a delamination or formation of cracks occurs.

Fig. 5 is a microscopy photography showing how the side layer of the especially preferred laminate has sunk down into the bulk layer. The figure illustrates the principle of the invention, as has been outlined in Fig. 4.

The invention is not limited to the embodiments described above, but may be varied within the scope of the following claims. Thus, it is e.g. realised that the side layer in some cases may be excluded on the side of the laminate which is creased by the creasing device, whereby the bulk layer is compressed without a side layer sinking down into it. It is also realised that the method is not limited to a laminate which exhibits a bulk layer of the specified freeness values and which exhibits the specified bending stiffness indexes, this type of laminate only serving to constitute a preferred laminate for the performance of the invention.